

The Power of Teamwork: Winning the 2007 Ergo Cup

Christine Naca



Overview

- Description of the JGI
- Overview of Production Tasks
- Ergo Cup Competition
- JGI Ergonomics Program



DOE Joint Genome Institute

- 250 Staff: 30% LLNL and 70% LBNL
- Mix of research and manufacturing work
- Integrated Safety Management (ISM)
- Stephen Franaszek (LBNL)

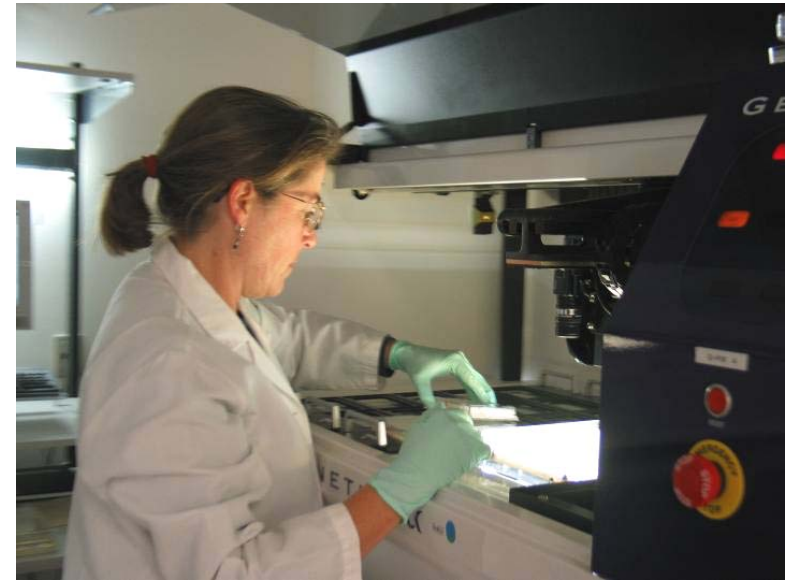


Walnut Creek, CA

Office & Manufacturing Work Environments



60% staff in computer-intensive office settings



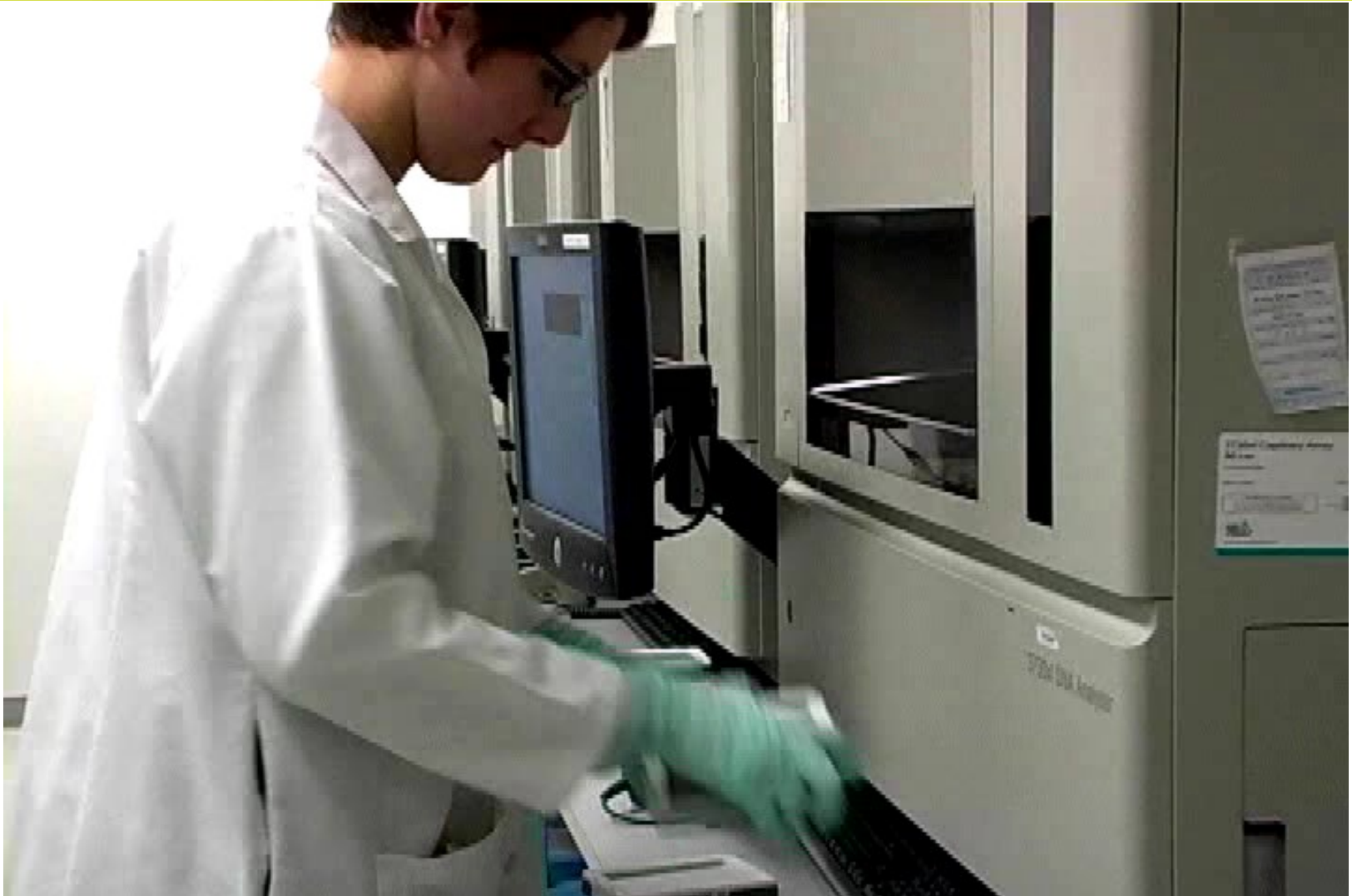
40% staff in hand-intensive production tasks (2 shifts)

Manufacturing Work Environment



- 40% of the staff make up the manufacturing work environment
- High throughput laboratory manufacturing
- Hand-intensive repetitive tasks
- 32 people, 2 shifts/day

Production Short Film



Plating Process Details

Purpose of Plating:

- To evenly spread individual bacteria onto agarose growth media.
- Bacteria grow into randomly spaced separate colonies that can then be picked, by robot, into microtiter plates.
- The result of the overall process is to put individual samples into individual sample wells.

Plating Process Details

Plating Process:

- Pour glass beads onto bioassay plate.
- Pipette solution onto bioassay plate.
- Stack 4-5 plates together.
- Shake and tilt the plates until the beads evenly spread the solution across the agarose gel on the plate.
- Remove the glass beads

Plating Stats:

- 9"x9" bioassay plates
- Weight: 1.2lbs/plate (low profile) or 1.4lbs/plate (high profile)
- 40 plates/batch
- 4-5 plates/cycle
- 1-2 minute shake time/cycle
- Approx. 100 efforts/minute
- Total processing time 40 minutes

Plating Process Film



Plate bacteria

5

Ergo Evaluation Techniques

Semiquantitative Assessment Methods

Quantitative Assessment Methods

Moore-Garg Strain Index

- Estimates the risk of injury to the distal upper extremity (elbow and below)
- Integrates risk factors: force, repetition, posture, recovery time, and duration of the day

Moore-Garg Strain Index

Job / Task: **Plating, Manually with High Profile Bioassays**

Date: **12/13/2006**

Analyst: **Christine Naca, Ira Janowitz**

SI Score Interpretation
< 3 Safe
3-5 Uncertain
5-7 Some Risk
> 7 Hazardous
Product of all multipliers

SI = **60.8**

| Variable | Rating Criterion | Observation | Variable Multiplier | Enter Multiplier | %Max, MVC |
|---|------------------|---|---------------------|------------------|-----------|
| Intensity of Exertion (BS is Borg Scale) | Light | Light: Barely noticeable or relaxed effort (BS: 0-2) | 1 | | <25% |
| | Somewhat Hard | Somewhat Hard: Noticeable or definite effort (BS: 3) | 3 | | 25-35% |
| | Hard | Hard: Obvious effort; Unchanged facial expression (BS: 4-5) | 6 | | 35-55% |
| | Very Hard | Very Hard: Substantial effort; Changes expression (BS: 6-7) | 9 | 9 | 55-75% |
| | Near Maximal | Near Maximal: Uses shoulder or trunk for force (BS: 8-10) | 13 | | >75% |
| Duration of Exertion (% of Cycle) | < 10% | | 0.5 | | |
| | 10-29% | | 1.0 | | |
| | 30-49% | | 1.5 | | |
| | 50-79% | | 2.0 | 3.0 | |
| | > 80% | | 3.0 | | |
| Efforts Per Minute | < 4 | | 0.5 | | |
| | 4 - 8 | | 1.0 | | |
| | 9 - 14 | | 1.5 | | |
| | 15 - 19 | | 2.0 | 3.0 | |
| | > 20 | | 3.0 | | |
| Hand/Wrist Posture | Very Good | Perfectly Neutral | 1.0 | | |
| | Good | Near Neutral | 1.0 | | |
| | Fair | Non-Neutral | 1.5 | | |
| | Bad | Marked Deviation | 2.0 | 3.0 | |
| | Very Bad | Near Extreme | 3.0 | | |
| Speed of Work | Very Slow | Extremely relaxed pace | 1.0 | | |
| | Slow | Taking one's own time | 1.0 | | |
| | Fair | Normal speed of motion | 1.0 | | |
| | Fast | Rushed, but able to keep up | 1.5 | 1.0 | |
| | Very Fast | Rushed and barely/unable to keep up | 2.0 | | |
| Duration of Task Per Day (hours) | <1 | | 0.25 | | |
| | 1 - 2 | | 0.50 | | |
| | 2 - 4 | | 0.75 | | |
| | 4 - 8 | | 1.00 | 0.25 | |
| | > 8 | | 1.50 | | |

Note: This worksheet was adapted and interpreted by the USF investigators. No warranty is offered.

Reference: J. Steven Moore & Arun Garg, Thomas E. Bernard and Robert B. Walton
The Strain Index: A Proposed Method to University of South Florida
Analyze Jobs For Risk of Distal Upper College of Public Health
Extremity Disorders; Am. Ind. Hyg. Assoc. Tampa FL 33612-3805 (813) 974-6629
J. 56:443-458 (1995) tbernard@hsc.usf.edu and rwalton@hsc.usf.edu
Partial support from v2.2 1/11/01 © 2001 Thomas E. Bernard
UAW-Ford NJCHS For updates, see Stone Wheels at www.hsc.usf.edu/~tbernard
Ford Motor Company No Warranty: Expressed or Implied.
US Air Force

Manual Plating Process

Problem

Risk Factors:

- High grip force when handling 5 plates/cycle
- Wide (4") grip span (low profile)
- Grip Force 30-41% of maximum voluntary contraction; Moore-Garg Strain Index = 40.5

Musculoskeletal Problems:

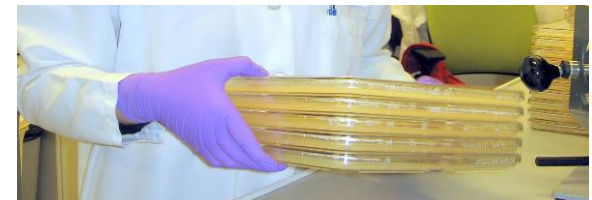
- Awkward hand and wrist postures to repeatedly tilt and rotate the plates for 40 min/batch
- Reports of discomfort and fatigue in operators in upper extremities, shoulders, and back.

Workstation Layout:

- Conducted at a fume hood in a high traffic walkway
- Does not accommodate a sitting workstation due to the lack of leg clearance.

Efficiency:

- 4 plates per cycle manually, limited by weight (8-10lbs) & awkward grip of plates

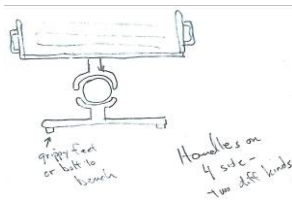


SHAKE 'N PLATE

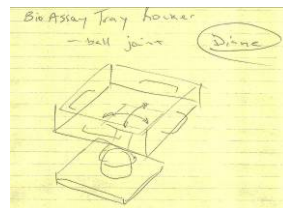
TEAM ERGONOMIC SOLUTION



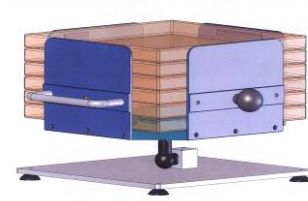
Hand-held
Manual process



Technologist
Sketch of
Solution



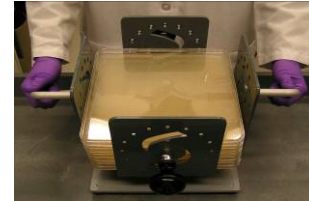
Mechanical
Engineering
Sketch of
Solution



Mechanical
Engineering
Technical
Design



Initial
Engineering
Prototype
(too heavy)



Final
Manual
Tool

Solutions were initiated by production line operators' participation in process improvement.

SHAKE 'N PLATE

Solution

Intermediate Interventions:

- Lighter weight low-profile bioassay plates (reduced weight by 19% and grip span to 3")
- Risk factors still high (Strain Index dropped from 60.8 to 40.5).

Workstation Layout:

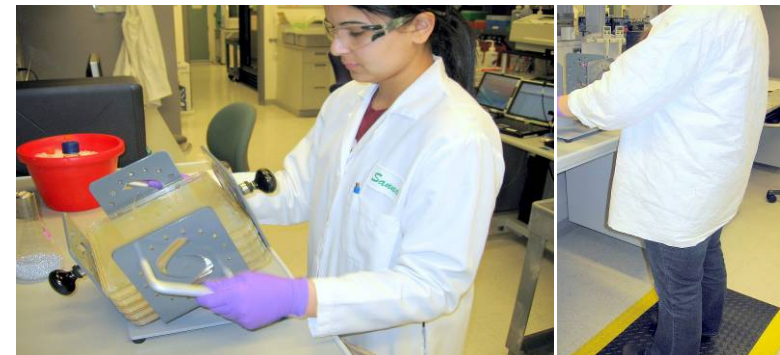
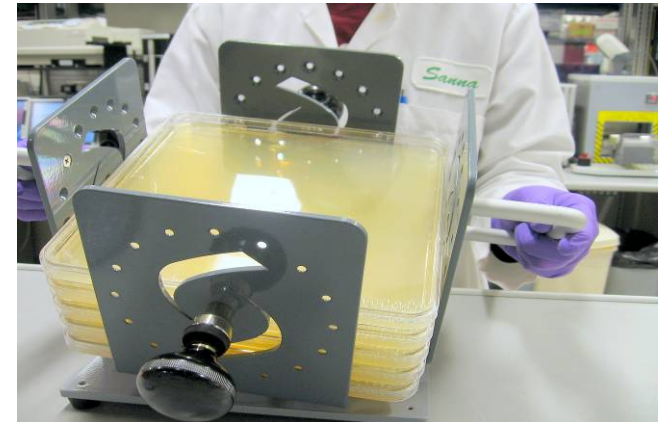
- Process was moved out of fume hood onto a lab bench (less foot traffic)
- Accommodates option of sit down or standing workstation (adequate leg clearance and better quality anti-fatigue mat)

Tool:

- Swiveling manual plating fixture with 3 degrees of freedom, eliminating the sustained gripping of the plates (dropped Strain Index to a 'safe' score of 2.3).

Efficiency:

- The acceleration, tilt, and rotation of the fixture are controlled by the operator. (Important for the glass beads to travel across entire plate in order to efficiently produce high quality bacterial colonies, critical for subsequent steps in the production process).



Shake 'N Plate



Before



After

Administrative:

- Leg Room for seated option

Off the Shelf:

- Lighter plates
- Anti-fatigue Mat

Engineering (custom):

- Fixture to hold the plates

Increased Productivity:

- 25% ↑ throughput

Outcome

| | |
|----------------------------|--|
| Safety | <ul style="list-style-type: none"> •Grip Force 14-19% of maximum voluntary contraction •Moore-Garg Strain Index = 2.3 |
| Quality | <ul style="list-style-type: none"> •The quality of the sample did not change. |
| Delivery/Efficiency | <ul style="list-style-type: none"> •Process 5 bioassays per cycle with fixture. •Increased throughput by 25%. |
| Cost | <ul style="list-style-type: none"> •Reduction in process time by 25% •ROI (10 years) = 0.6 months •Since the intervention, production staff reports no discomfort after plating, and no injuries have occurred in association with this task. |
| Morale/Teamwork | <ul style="list-style-type: none"> •Participatory process → production staff design concept. •The new workstations ↑ flexibility for multiple operators. •Increased morale due to improvement of task and potential for future automation & cross training. |

2007 Ergo Cup Competition

10th Annual Applied Ergonomics Conference



2007 Ergo Cup Winners

“Team Driven Workplace Solutions”



Evolution of Shake 'N Plate



BEFORE



MANUAL INTERVENTION



CURRENT INTERVENTION
Automated System

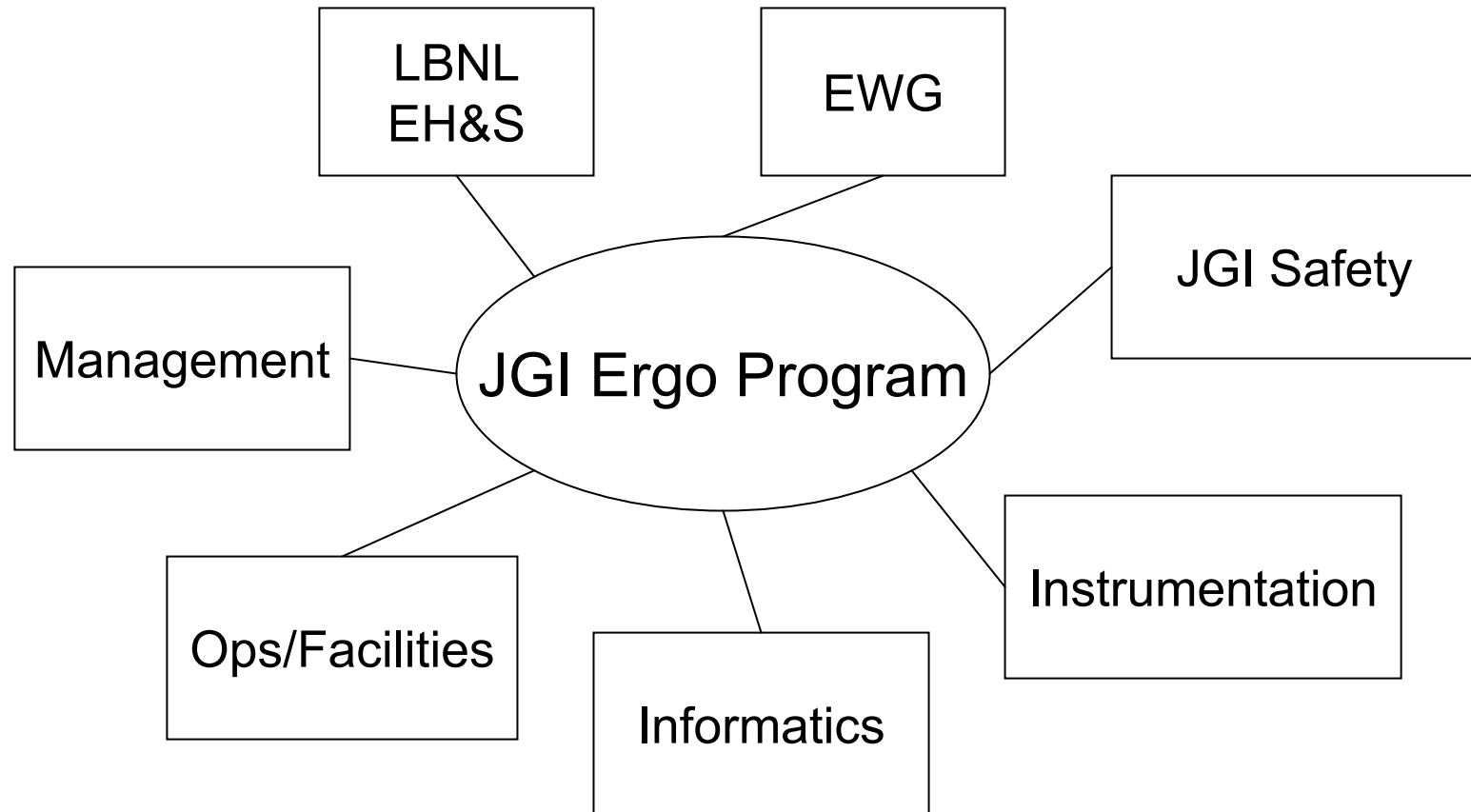


The JGI Ergo Program

Why Are We Having Success?

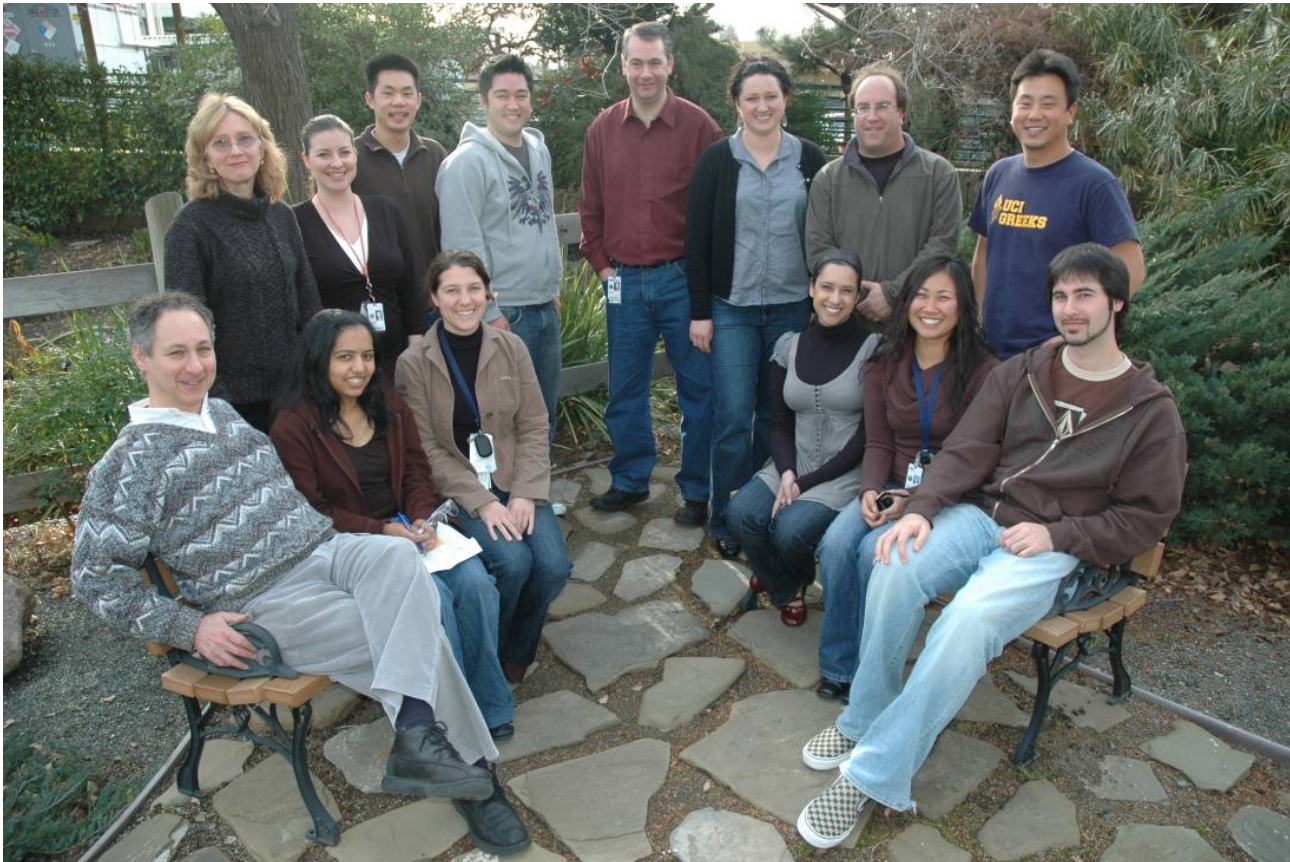
- **Teamwork**
 - Employee-led Ergonomics Working Group
 - Management Commitment
- **Identify Solutions**
 - Quick Fix-Administrative Solutions
 - Long Term-Engineering Solutions
- **On-Site Ergo Support**
 - Rapid Response
 - Encourage Early Reporting
- **Communication/Education**
 - Group Meetings
 - Posters
 - Weekly Ergo Email
 - Custom Ergo Training Courses

Managing Ergonomics Team Effort



Engaging the Staff

Ergonomics Working Group



Current Ergo Project Status

| Classification | Category | Closed | In Progress | Grand Total |
|----------------|---------------|--------|-------------|-------------|
| Administrative | | 48 | 8 | 56 |
| Engineering | Custom | 40 | 17 | 55 |
| | Off the Shelf | 51 | 16 | 65 |
| Grand Total | | 139 | 41 | 180 |

Ergo Projects by Classification

Communication and Education

JGI
DOE JOINT GENOME INSTITUTE
US DEPARTMENT OF ENERGY
OFFICE OF SCIENCE

Warm Up Program 1

At JGI we are committed to taking positive actions in helping our employee's prevent repetitive stress injuries. One of these actions is to ask each employee in the production line to take a five-minute break every hour. This break is intended to give the production team some time outside of their work areas to walk, relax, or do this approved program of ergonomic exercises.

Some of these exercises can be performed by our employee's any time during the day in their work areas, but this hallway ergonomic program, designed by Ronnie Balan, a physical therapist at LLNL Ira Janowitz, JGI ergonomist, and approved by Stephen Franaszek, JGI Safety Office, is designed to meet our production employees' specific ergonomic needs efficiently and safely.

Exercises can be done as a group or alone.

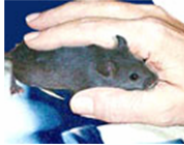
Most are done slowly unless noted. All should be held only to a comfortable tension. Start with 3-5 seconds. They should not hurt. If you are under medical care check with your health care practitioner.

As time permits or if discomfort occurs, try some of the movements during the day.




Stretch Posters


JGI ERGO ROOM



Do you ever experience discomfort from using your mouse because it's too small?



Does your keyboard cause you to bend your wrists into an uncomfortable position?



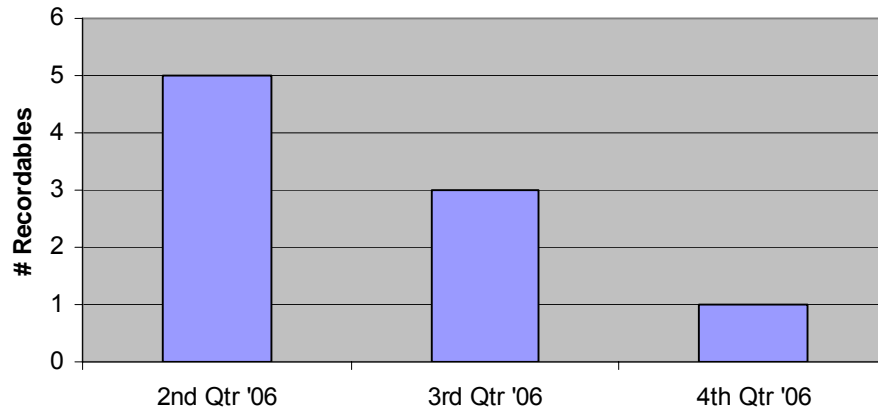
Did you know that there ARE options available?

The JGI now has an ergonomic demo room available to try out alternatives to your standard keyboard and mouse. We have set-up a computer that will enable you to experience a better workstation layout using a mouse and keyboard that fits your needs. The demo room is located in **building 400, room 405**. If you are interested in trying out any of the equipment, please contact Mike Lee in Safety (ext 5649) or via email at: mdlee@lbl.gov to schedule an appointment.

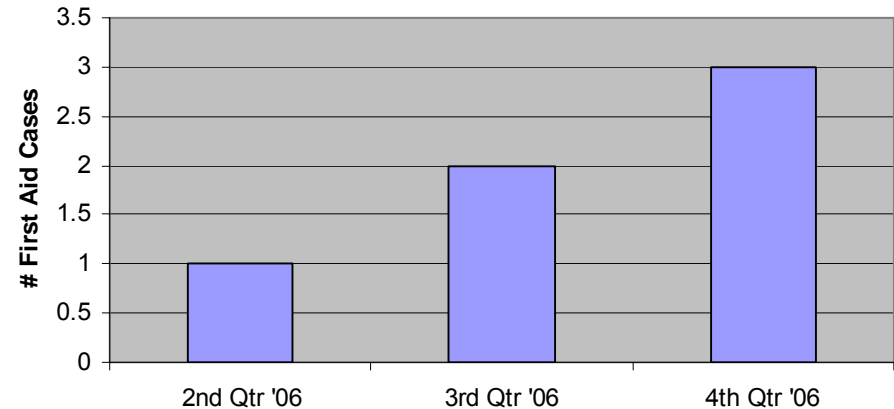
Potty Training

JGI Ergonomic Injury Summary CY 2006

Recordables



First Aid



Challenges

- **Equipment/instruments designed for small batches/small lab use now being used for high throughput operation**
- **Culture:**
 - **Understanding Efficiency vs. Speed**
- **Regular Breaks and Lunch**
- **Mix of hand-intensive activities**
- **Overtime practices**
- **Staffing issues**

In Summary

- **Collaborative Effort**
- **Continuous Improvement**
- **Proactive and Participatory Ergonomics Program**

Results:

- **Improved Employee Morale**
- **Decreased Recordable Injuries**
- **Winner of 2007 Ergo Cup for “Team Driven Workplace Solutions”**



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Project Team: Diane Bauer, Christine Naca, Simon Roberts, Karl Petermann, Charles Reiter, Catherine Adam, Sanna Anwar, Miranda Harmon-Smith, Karli Ikeda, Ira Janowitz, Martin Pollard, Damon Tighe